The Smarter Balanced Technology Strategy Framework and System Requirements Specifications

Smarter Balanced
Assessment Consortium

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Smarter Balanced is a state-led consortium developing assessments aligned to the Common Core State Standards in English language arts/literacy and mathematics that are designed to help prepare all students to graduate high school college- and career-ready.

Introduction

This report presents a framework for collective technology planning among the Smarter Balanced Assessment Consortium member states. The plan emphasizes the critical need for technology to support student learning with the Smarter Balanced Assessment System minimum requirements as context and milestones. The minimum requirements are based on expert judgments regarding instructional technology, district interviews, input and feedback from various national experts, specific guidance and direction from the Smarter Balanced executive team and the Technology Approach Work Group, and an independent review of data collected from the Smarter Balanced Technology Readiness Tool.

These data and reviews indicate that the administration of online adaptive assessments, similar to those administered in a number of Smarter Balanced states at this time, can largely be executed with the hardware and infrastructure that exists in schools today. Key strategies for successful implementation of the Smarter Balanced Assessment System will include:

- Implementing strategic approaches to testing schedules that leverage the testing window.
- Evaluating and addressing any problems with actual bandwidth levels at a given school site (i.e. the pipeline throughout the school, not just the bandwidth to the school).
- Ensuring continual basic maintenance and upkeep of existing assets.

This report describes two levels of hardware specifications: minimum specifications and recommended guidelines. A school that implements only the minimum specifications (e.g., bandwidth and computers) will be able to implement the Smarter Balanced Assessment System successfully, but the individual testing experience for any particular student may have periods of slowness during which the computer experiences brief moments of data lag or delay, which will not disable the exam, but will merely result in the system taking a few additional seconds to capture student responses and render the next question or item. In addition, some students with special needs may not be able to use computers that meet only the minimum specifications. Students in schools that implement the Smarter Balanced Assessment System in a manner consistent with the recommended guidelines will tend to experience few, if any, periods of slowness as described and will have a more fluid testing experience.

Smarter Balanced intends for there to be at least two methods by which states are able to implement the Smarter Balanced Assessment System.

1) States will be able to administer the Smarter Balanced Assessment System using the Smarter Balanced–developed applications by procuring hosting and helpdesk services.

2) States will be able to procure Smarter Balanced–certified comparable test administration platforms as well as hosting and help desk services. Smarter Balanced's Architecture Review Board is considering methods to establish comparability among test administration platforms.

Although comparable approaches to administering the Smarter Balanced Assessment System are likely to have similar requirements to the Smarter Balanced–developed applications, this document only describes the requirements to use the Smarter Balanced–developed applications.

Two additional factors should be considered when reviewing this document:

1) The specifications described in this document are minimum specifications necessary for the Smarter Balanced assessment only. Minimum specifications to support instruction and other more media-heavy applications are higher than those necessary for the assessment.

2) The Smarter Balanced minimum specifications for assessment were deliberately established as a low entry point to help ensure that technology-purchasing decisions are made based on instructional plans and to increase the likelihood that schools will successfully engage in online testing.

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I. Overview of the Smarter Balanced Technology Strategy Framework

By 2014–15, most students in public schools will engage with a variety of computer-based instructional modules and/or computer-based assessments. The rationale for this trend is well described in the U.S. Department of Education's regulations regarding the Race to the Top Assessment Program:

> *States need assessment systems that better reflect good instructional practices and support a culture of continuous improvement in education by providing information that can be used in a timely and meaningful manner to determine school and educator effectiveness, identify teacher and principal professional development and support needs, improve programs, and guide instruction.*
>
> — Overview Information; Race to the Top Fund Assessment Program, USDOE Federal Register, Vol. 75, No. 68 (http://www.gpo.gov/fdsys/pkg/FR-2010-04-09/pdf/2010-8176.pdf)

As a continuing part of their local efforts to better serve their students and as participants in the Smarter Balanced Assessment Consortium, schools, districts, and states are evaluating the capacity of their schools through surveys of existing technical infrastructure and devices and potential future purchasing trends. These data are being used to derive strategies in response to the desire to move national assessment instruments, processes, and data aggregation and reporting into the digital age.

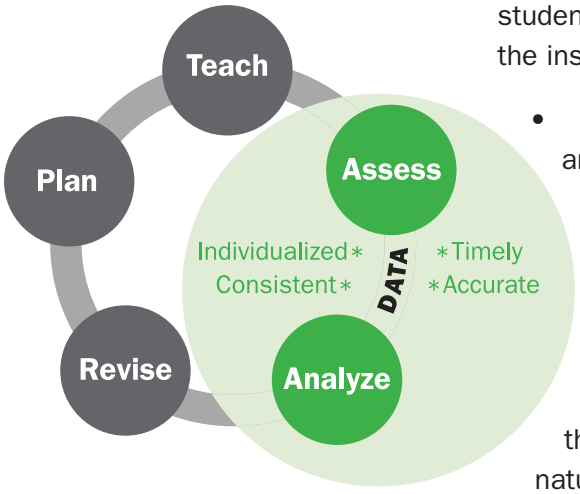
Implementing a watershed change in the use of educational technology by 2014–15 is made more complex by the growing shift in computing device form factors, which will inevitably involve one of the largest hardware/software migrations encountered within education over the last 25 years. During this transitional period, districts will rely heavily upon the traditional desktops and laptops that all educational institutions have used as the core framework for their technical ecosystems, while simultaneously testing and planning for more mobile data- and network-enabled devices (tablets, e-readers, smartphones, etc.) that have penetrated the consumer markets and the lives of students and teachers.

Despite significant challenges, there is a clear opportunity for dramatic success. By developing a common assessment with common technology requirements, states and districts create a roadmap for the requirements of the future. In addition, the diversity of device types that are available provides districts with a range of options that can best address their specific program needs. Finally, there are many states that can serve as exemplars of success regarding online assessment, online instruction, and technology planning. By combining the expertise of these states, the best elements of existing programs and descriptions of educational technology best practices can be identified.

As such, this document is intended to be a living document that provides districts with basic information that is necessary to assist them in their plans for the continued use of legacy systems as instructional resources and as delivery devices for online assessments. Many districts will, by design or by need, have to consider the implementation of changes to their systems of information technology. This may include some elements of new hardware in the form of desktops, laptops, and thin clients, as well as devices less familiar to district IT support personnel, including mobile devices such as tablets. Changes in devices may require subsequent changes to networks such as including new wireless networks or upgrading existing wireless networks. Many districts will have to establish new policies to address the new technologies such as 1:1 initiatives, processes for checking computers out through the school's library/media center, moving devices from class to class in a cart, and the use of student-owned/-managed devices.

Districts will be asked on various levels to explain the impetus for changes to their local technology plans and the reasons behind them. Whether working with individual schools and the instructional staff or communicating with their local stakeholder organizations and community, this document will also assist districts in better articulating that the national programs and local strategies require different technologies to yield the full anticipated benefits of teaching and learning improvements.

The Smarter Balanced Technology Strategy Framework and System Requirements Specifications



Defining Learning Analytics

Learning analytics loosely joins a variety of data-gathering tools and analytic techniques to study student engagement, performance, and progress in practice, with the goal of using what is learned to revise curricula, teaching, and assessment in real time…A key application of learning analytics is monitoring and predicting students' learning performance and spotting potential issues early so that interventions can be provided to identify students at risk of failing a course or program of study.

— Johnson, L., Smith, R., Willis, H., Levine, A., and Haywood, K., (2011). The 2011 Horizon Report. Austin, Texas: The New Media Consortium.

These advantages include:

- **Timely Data:** Immediate access to individual student performance data to help educators more readily know where students are on a given continuum of skills can better support the instructional planning processes.
- **Individualized, Accurate Assessment:** Districts' teachers and instructional leaders can deliver specific computer-adaptive interim and summative assessments tailored to the needs of various students. As students encounter assessments that actively calibrate performance item-by-item, a more precise pathway is generated to understand students' levels of proficiency and to better identify the specific individual skills they possess as well as the gaps that persist in their performance over time. The adaptive nature of this test is particularly suited to addressing the special needs of some learners with specific adaptations tailored to their unique designations.
- **Accessible Reports:** Structured and adaptable information on student achievement across grades and subject areas enables teachers, administrators, and district leaders to have focused, data-supported dialogue on students' needs to better articulate support, communication, and budgets around those needs.
- **Increased Efficiency and Security:** There will be a significantly reduced need to produce and physically secure, transport, and disseminate hard-copy assessments and to require constant and scrupulous monitoring of millions of paper items across districts and states.

States that use computer-based assessments typically have more capacity in the form of data structures to quickly pinpoint student progress toward learning outcomes. The strategic type of **Learning Analytics** that can be generated from these data structures increases schools' and districts' capacity to convert the data into information that can inform the instructional analysis and planning cycle. Intervention plans for students not meeting achievement expectations can be targeted and specific to precise skill gaps. Finally, computer-based assessments are more conducive to identifying successful programs that can be replicated.

With a robust technology system that supports computer-based instruction and assessment, the understanding of student needs allows educators to more quickly identify gaps in effective instructional content and address those gaps by procuring a diversity of materials aligned to the Common Core State Standards as to share successful instructional strategies that leverage those materials. Policymakers at district and state levels can make informed decisions about the strategic allocation of resources by analyzing where investments have generated results, and the degree to which students are experiencing similar success consistently across schools and districts.

The information provided herein is a compilation of data, research, general form-factor specifications, and field-based analysis generated through a broad spectrum of input, recommendations, and interviews. The intent of this material is to assist districts within Smarter Balanced in creating a forward-looking vision and related strategies for the implementation of next-generation assessments that accurately measure student progress toward college- and career-readiness as aligned to the Common Core State Standards by 2014–15.

"When considering the transition to online tests, I would want other districts in other states to emphasize money, resource and time savings; ease of exam organization and administration; and immediate feedback, as direct benefits to teachers and students."

— Oregon School District Administrator of Technology and Assessment

As a lead-in point, it is important to note that a common theme resonated across numerous direct interviews and inquiries with state department-level personnel and district technology and assessment coordinators directly involved with administering online computer-adaptive tests; these tests save time and money, and teachers are vehement that the tests have helped them to better understand their students' needs. They are able to have better conversations about students and learning, and they would be averse to returning to their traditional assessment methods.

Based on the general research and data reviews conducted for the development of these guidelines, we believe that most districts will find much of their existing infrastructure and device inventory will serve to administer the online assessments. By all estimations at this time, the need for states and districts to secure large volumes of hardware and infrastructure purchases between now and the 2014–15 school year is not consistent with the implementation data available. Where purchasing considerations are necessary, the information within this document will assist in early thinking and considerations for districts and schools.

II. Summary of Statewide Technology Readiness Survey

*School Systems Trends Nationally

Common survey data from United States schools continues to illuminate an array of existing hardware/software deployed across myriad networks and infrastructures. However, even with this seemingly diverse tapestry, certain trends or configuration patterns surface in terms of how K-12 provisioning of hardware, operating systems, and network data infrastructures have been designed over the past decade.

*Technical trends data are largely drawn from *A Summary Report for the July 15, 2012 Data Snapshot* as prepared by Pearson for Smarter Balanced and PARCC.

- **Hardware:** Primarily Windows-based desktops and laptops
- **Operating Systems:** Primarily Windows XP or 7
- **Productivity Software:** Microsoft Office Suite (2003–2010)
- **Network Data Bandwidth:** (incoming/internal): 10 Mbps/10–100 Mbps

To rely exclusively on this "majority profile" would misrepresent the whole picture; however, as there are significant numbers of schools in all states running everything from Mac OS 10.3 on "clamshell"-style iBooks to new tablets running Android's Ice Cream Sandwich.

Therefore, this document will examine a number of these data, as related to the trends that have surfaced across the nation, and ask that districts then consider this global information prior to distilling it to a more specific study of their own technology readiness for implementation of the online computer-adaptive assessments to be executed in the 2014–15 school year.

Overview of Report Data	Type of Site-Based Devices in General
Total Device Counts in Report: **5,977,387** Total District Counts in Report: **11,789** Total School Counts in Report: **56,268**	• 59.6% of devices are desktops/laptops • 10.1% are netbooks, tablets, or other mobile-type units *30.3% of devices in count were not specified by type.*

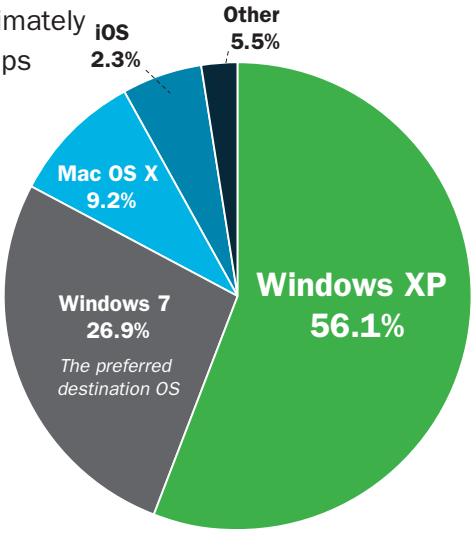
As shown above, the data set for assertions made within this document is derived from a large device count. While some discrepancies can be found in the more granular information collected from states, in terms of non-responses and culling of federal data in place of a direct, current accounting for some items, the overall trends presented are valid and persistent across states due to the overall size of the sample.

As such, if we can assume that the 30.3% of devices that went unidentified (primarily due to two states' failure to report information on device type) were to follow the desktop/laptop-to-mobile device ratio established by those states that did report device type, approximately 85% of the computing devices in districts are desktops or laptops and 15% are mobile devices.

Operating System Trends in U.S. K-12 Schools

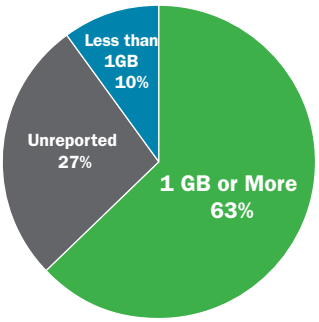
District Takeaway #1: Plan to migrate from Windows XP to newer OS within two years of Microsoft's support end date of April, 2014.

While the online assessment will be able to run on Windows XP in 2014–15, districts are strongly urged to consider a transition plan to migrate units off of Windows XP, as it will be a non-supported OS by April of 2014 according to Microsoft. At this time, Windows 7 is a preferred destination OS. Windows 8 has not been fully tested, but is anticipated as an acceptable OS for Smarter Balanced assessments in coming years. Please note that this is only a recommendation; Windows XP will continue to be a viable OS to execute the assessment solution package beyond Microsoft's support end date, and many districts will still have other programs that are dependent on XP in various instances.



Operating Systems Deployment

The graph above shows current operating systems usage. Districts are strongly urged to consider a transition plan to migrate units off of Windows XP.



Internal Memory

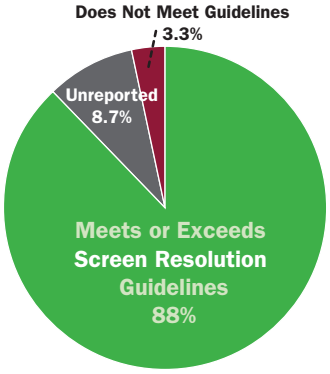
The graph above shows current internal memory usage. Districts should upgrade computers to at least 1 GB of internal memory.

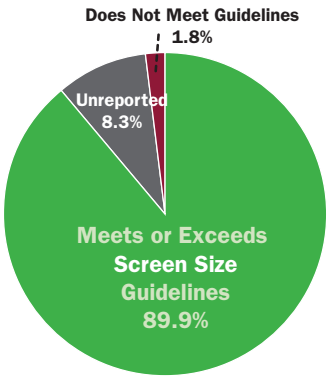
Internal Memory Trends in U.S. K-12 Schools

District Takeaway #2: all districts should upgrade computers to at least 1 GB of internal memory.

It is anticipated through projecting the trends seen above that the majority of the unreported numbers would most likely end up coming in at 1 GB or more in internal memory. New purchase guidelines call for at least 1 GB and in terms of upgrading older machines, internal memory is one of the least expensive and easiest upgrades to conduct.

It is important to note that computers meeting the minimum required operating systems, with ample bandwidth, can and will be largely marginalized in their overall performance if enough internal memory is not accessible to run browsers simultaneously with other core operations on a given unit. And, given the relatively low-costs for upgrading memories as stated above, it is recommended that district's perform such upgrades as a means to enable more units for effective assessment use.





Screen Resolution and Screen Size Trends in U.S. K-12 Schools

District Takeaway #3: Ensure that devices have a visual display of no less than 9.5-inch screen dimension (10-inch class) supporting at least 1024x768 resolution.

While it was reported across multiple states and districts that 8–9.5-inch screen dimensions supported the online assessment solution, 9.5 inches is the preferred width. Additionally, while many tablet screen sizes align with these dimensions, districts will need to consider the amount of visual space the virtual "on-screen" keyboards consume when utilized as the primary input method. Districts planning to use tablets should consider having external "plug and play" keyboards for students needing to maximize viewing space on their devices.

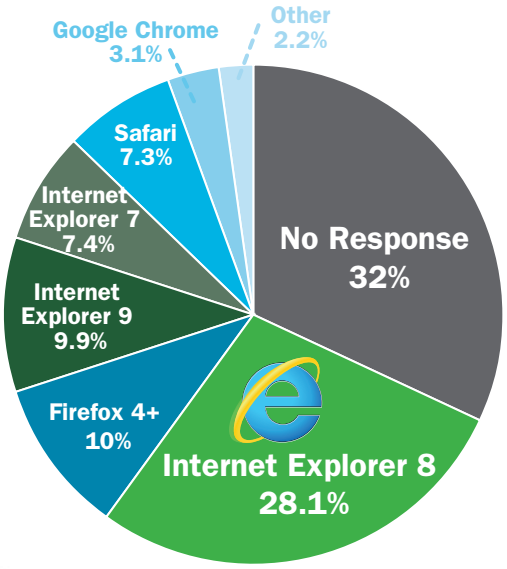
Screen Resolution and Screen Size Trends

The graphs on the left show current screen resolution and screen sizes. Districts planning to use tablets should consider having external "plug and play" external keyboards for students needing to maximize viewing space on their devices.

Internet Browser Trends in U.S. K-12 Schools

District Takeaway #4: The student testing site ultimately operates on secure browsers.

While various components of the online assessment package (such as the test administrator live site, training site, and the online student practice tests) are executed on various web browser/OS configurations, the actual student testing site can only be operated on a series of secure browsers as generated by the Smarter Balanced solution for various operating systems. *(An example of the AIR's existing secure browser download interface is below.)*



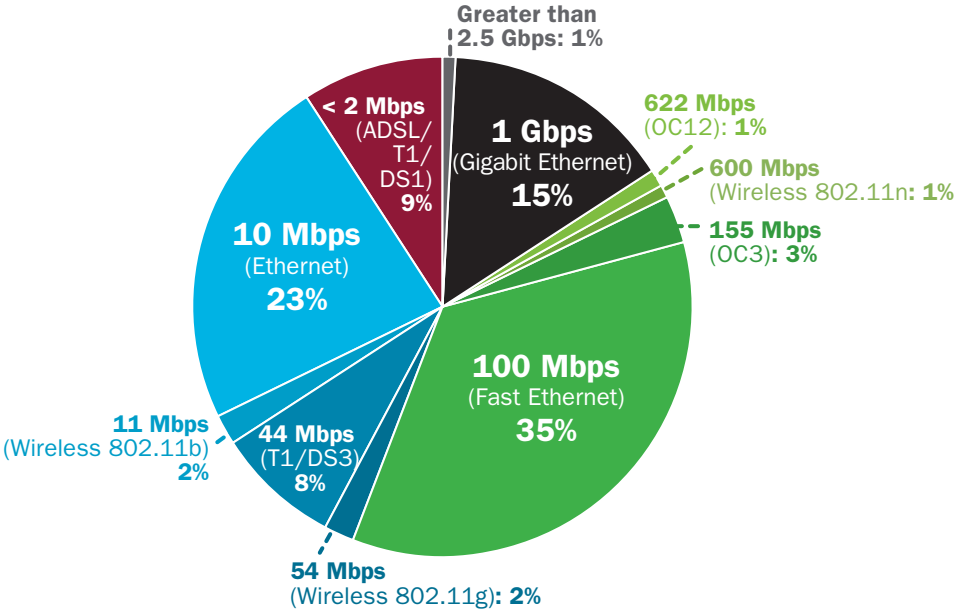
Secure Internet Browsers

The graph above shows current Internet browser usage. Districts should plan to download the latest secure browser from the AIR website.

In general, various versions of Internet Explorer, Safari, and Firefox are supported on the non-student assessment tools online. A full table of browser and OS compatibility specifications will be made available in Section III of this document for accessing those other, various parts of the assessment bundle.

Internet Connection and Internal Bandwidth Trends in U.S. K-12 Schools

District Takeaway #5: Once the assessment is running, estimates show it draws approximately 5–10 Kbps per student for most current testing.



Site Internet Connection

*In addition to the graph's connectivity data, schools' internal network bandwidth is largely reported at 100 Mbps to 1 Gbps (90% of responding sites).

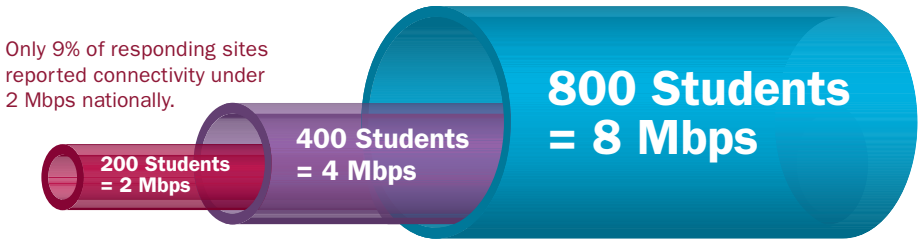
American Institute for Research

The American Institute for Research (AIR) has received the Smarter Balanced contract to develop the online adaptive assessment component. The following information is a compilation of materials and information published courtesy of AIR and can be used as general, preliminary assertions for bandwidth calculations.

These tests include animations, technology-enhanced items, and other state-of-the-art functionality.

The actual bandwidth demands will depend on the media included in the Smarter Balanced tests. For example, one English language proficiency test includes recorded audio and a speaking component, which captures oratory responses. This type of media can increase the bandwidth. We currently estimate that the Smarter Balanced assessment will require 10–20 Kbps per student or less.

For basic calculations, consider the typical bandwidth draw of 10 Kbps and multiply by number of students for an estimate of bandwidth needs to deliver the assessment in its most intensive iteration. Therefore, 100 students assessing simultaneously could draw up to 1,000 Kbps (1 Mbps) as a reasonable estimate.



If districts base their general calculations for every **100** students as a multiple of **1 Mbps** to predict the highest estimated bandwidth needs for the most "network-intensive" parts of the test, they can create basic, peak requirement calculations.

Of course, **it is important to note** that all districts will ultimately want to make use of the network diagnostic assessment tools that will be developed to finalize local testing and calibrate definitive load specifications for each school site and devices therein, **particularly when the school is in session and drawing bandwidth to other, daily network and data-intensive operations on campus.**

For wireless access, connections using an 802.11g access point can reliably support a maximum of 20 PC and/or Mac workstations that use wireless cards with either the 802.11g or the 802.11n standard. If your access point is 802.11n, and the devices are equipped with 802.11n cards, then up to 40 units can be supported over wireless given appropriate network connectivity.

(All estimates are dependent on ample bandwidth coming to the site and/or to the wireless access unit for distribution out to testing devices.)

Bandwidth Note

Sites with lower bandwidth (such as those still operating on T1 connections) can still deliver the assessment effectively, but will experience some latency in data transfer.

III. Overview of the Smarter Balanced Assessment System Implementation

Smarter Balanced's online assessment solution will use a standards-based computer-adaptive testing system in which items are selected to a) ensure that every student is tested on the full breadth and depth of content and b) provide each student with items that are both accessible and challenging. All public-facing components of the system are accessible via an online remote portal and can be accessed by a variety of common web browsers for the administrative and diagnostic resources, while the actual student test itself is accessible online via a secure browser released for supported operating systems. Access to various applications is dependent on user roles, which will be defined by the Consortium. The Smarter Balanced assessment is a fully enabled, web-based application and requires no local hosting, caching, or servers.

Current versions of the online assessment solution are made up of the following primary components: Test Information Distribution Engine, Training Site, Student Practice Tests, and Operational Testing Sites.

"In our state, we were planning to phase in computer-based, online testing with AIR starting in 2008 with an anticipated full implementation to occur over a 3 year cycle, but when we encountered significant budget constraints in '09-'10, we opted to implement the online assessments as a replacement to our existing paper/pencil programs as a cost-savings decision. Despite that some allocations had to be made to increase our device numbers in certain schools, we were ultimately able to significantly decrease our overall assessment administration budget and had a fraction of the security incidents we previously had to investigate and document."

— State Dept. of Education Technology & Assessment Personnel

Data Reporting Facets and Dashboards

Wireless Generation has been identified as the Smarter Balanced vendor for data-aggregation and reporting systems and features. While they are just now beginning their initial steps in analyzing the reporting needs of Smarter Balanced districts and schools, initial recommendations for browsers to access data reports include **Google Chrome, Safari on iOS (Apple devices), Firefox, and Internet Explorer 8 and above.**

Each year, Smarter Balanced anticipates releasing a new set of secure browsers. These browsers prevent students from accessing other applications and copying or creating screenshots. The browser must be installed on each computer used for online testing. The secure browser must be installed on a yearly basis due to implementation of new features in the test delivery system and to support operating system updates. The browser can be installed individually on each computer or deployed to all computers through a distributed, remote administrative process across multiple computers on a school's network.

Secure browsers are necessary for delivery and access of the student assessments exclusively. However, all of the other components of the assessment package, including the Test Administration Tools, the Student Practice Tests, and the Test Administrator Interface, are facets that can be accessed by standard web browsers.

Secure Browser Specifications

Secure browsers are released annually for the student summative assessment in order to create a simple, secure interface for students to access only the test without any other online-enabled utility. With the secure browsers, students may only access the exam.

To deliver a secure summative assessment, the desktop needs to be restricted. This prevents students from accessing resources that compromise assessment results and otherwise allow students to breach the security of the assessment. To protect computers from malicious websites, browsers block access to operating system functions and do not generally allow server-side commands to control the computer. For example, without modification, off-the-shelf web browsers generally do not know if there are other programs running in the background (e.g., a recording program that might take pictures of the assessment items or record students' keystrokes). In contrast, the secure browser must monitor other activity on the computer and stop testing if any other programs run that may compromise the security of the test.

Although Smarter Balanced will continue to investigate the option of providing access to the assessment through server-based applets or commands, it is likely that secure browsers will continue to be required for at least the first two years of the operational assessment for most operating systems.

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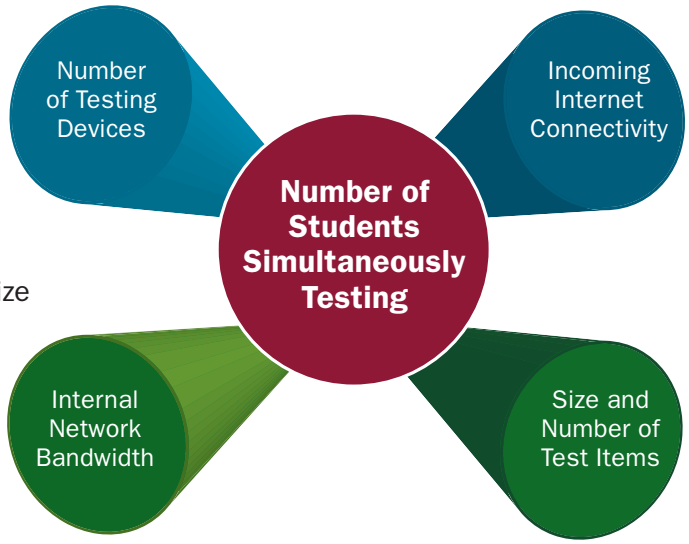
Operating System	Operating System Version	Secure Browser
Windows	XP, Vista, 7, 8 Windows Server 2003 and 2008	Windows Secure Browser as released prior to school start
Mac OS X	10.4.4, 10.5 with PowerPC	Mac Secure Browser as released prior to school start
Mac OS X with Intel	10.4.4, 10.5, 10.6, 10.7, 10.8	Mac Secure Browser as released prior to school start
Linux	Fedora 6 (K12LTSP 4.2+) Ubuntu 9-12	Linux Secure Browser as released prior to school start
To Be Developed for Tablet Form Factors:		
iOS	iOS6	iOS Secure Browser as released prior to school start
Android	Android 4.0	Android Secure Browser as released prior to school start
Windows	Windows 8	Windows 8 Secure Browser as released prior to school start
Chrome OS	Chrome OS (v19)	Chrome will use the native browser, and students will log onto an AIR domain to secure the system.

Smarter Balanced will release secure browsers for iOS6, Android 4.0, and Chrome OS; and these systems will be acceptable as testing devices by the 2014–15 implementation.

When administering the operational student test, the numbers of students that can simultaneously access and complete the assessment depends upon numbers of available devices and both the Internet connectivity and the internal network's capacity to distribute the incoming bandwidth delivered by that connectivity. Additionally, the size of the test itself and the size of each item as measured by bits of data per second can factor into delivery scenarios.



In preliminary interviews with both AIR and various districts administering the AIR solution it has been reported that its current states administer tests that can render within an average 5–10 Kbps per student bandwidth threshold. Additionally, all districts interviewed operated with an 8:1 to 11:1 student-to-computer ratio and were able to manage processing all students in a three-to-four-week assessment window. Smarter Balanced's assessment will render between 10–20 Kbps depending on whether or not a student is presented with a multimedia-based item. Smarter Balanced has reported its support of a twelve-week administration window to administer assessment components. Therefore, given data solicited for this report, districts should be able to accommodate even large-scale administrations by cycling rotations of grade-level assessment groups over time.

IV. Hardware and Software Requirements Overview

Basic hardware and operating system requirements developed by AIR for the Smarter Balanced assessment solution work to include a broad range of legacy systems and devices so that schools and districts can make use of many, if not most, of their existing investments.

Detailed information will be published by AIR as Smarter Balanced finalizes the test design and specifications. The chart below summarizes hardware and software specifications for both existing and new systems and can give districts a preliminary idea about their own local implementation planning for desktops/laptops/tablets.

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Operating System	Minimum Smarter Balanced Requirements for Current Computers[1][2][3]	Recommended Smarter Balanced Minimum for New Purchases
Windows	Windows XP (service pack 3) Pentium 233 MHz processor 128 MB RAM 52 MB hard drive free space	Windows 7+ 1GHz processor 1GB RAM 80 GB hard drive
Mac OS X	Mac OS X 10.4.4 Macintosh computer with Intel x86 or PowerPC G3 (300 MHz) processor, 256 MB RAM, 200 MB hard drive free space	Mac OS X 10.7+ 1 GHz processor 1GB RAM 80 GB hard drive
Linux	Linux (Ubuntu 9-10, Fedora 6) Pentium II or AMD K6-III 233 MHz processor 64 MB RAM 52 MB hard drive free space	Linux (Ubuntu 11.10, Fedora 16) 1 GHz processor 1GB RAM 80 GB hard drive
iOS	iPads 2 and 3 running iOS6	iPads running iOS6
Android	Android-based tablets running Android 4.0+	Android-based tablets running Android 4.0+
Windows	Windows-based tablets running Windows 8+	Windows-based tablets running Windows 8+
Chrome OS	Chromebooks running Chrome OS (v19)+	Chromebooks running Chrome OS (v19)+

Minimum Computer Requirements

Minimum requirements represent a low compliance threshold. Districts should attempt to exceed these requirements as many machines operating at these levels could struggle with sufficient on-board memory and processing to run secure browsers as well as other simultaneous running programs accumulated on the device over time.

[1] The minimum Smarter Balanced requirements are generally equivalent to the minimum requirements of the associated eligible operating system. Users should refer to the minimum requirements of the operating system as a means of resolving any ambiguities in the minimum Smarter Balanced requirements.

[2] These guidelines do not supersede the minimum requirements of the operating systems.

[3] All hardware choices should consider the individual needs of students. Some students may need hardware that exceeds these minimum guidelines, and some students may require qualitatively different hardware.

Additional Requirements Applicable Across Operating Systems:

Device Requirements	Minimum Smarter Balanced Requirements for Current Computers
Screen Size	10'' class or larger 1024 x 768 resolution
Headphones/earphones	Available to students for use during the English language arts test and for students who require text-to-speech features on the mathematics test
Security	The device must have the administrative tools and capabilities to temporarily disable features, functionalities, and applications that could present a security risk during test administration.
Keyboards	Mechanical keyboards must be available unless students use alternative input devices as part of their classroom instruction.
Form Factors	No restriction as long as the device meets the other stated requirements. These forms include desktops, laptops, netbooks, virtual desktops and thin clients[4], tablets (iPad, Windows, Chromebooks, and Android), and hybrid laptop/tablets.
Network	Must connect to the Internet with approximately 10–20 Kbps available per student to be tested simultaneously

Minimum Requirements for Other Devices

Minimum requirements represent a low compliance threshold. Ultimately, districts should attempt to exceed these requirements as many machines operating at these levels could struggle with sufficient on-board memory and processing to run secure browsers as well as other simultaneous running programs accumulated on the device over time.

[4] The resources (e.g., memory and processors) available to each client need to be equivalent or greater to the requirements for standalone hardware.

Printers

Test administrators can print out test session information and in certain situations can approve student requests to print reading passages, and in very restricted circumstances print test items. It is strongly recommended however that test administrators be connected to a single local or network printer in the testing room.

Headphones

The English-language arts assessments contain audio (recorded and/or computer-based read-aloud), and students must be provided with headphones so they have the option to clearly listen to the audio in these tests. Similarly, some students may need the support of text read-aloud by the computer as part of the mathematics assessment. In these cases, students should be provided headphones as well. Districts are encouraged to test the quality of the headphones in advance, as many districts and schools opt to purchase fairly inexpensive, bulk-type units when it comes to headphones for general student use.

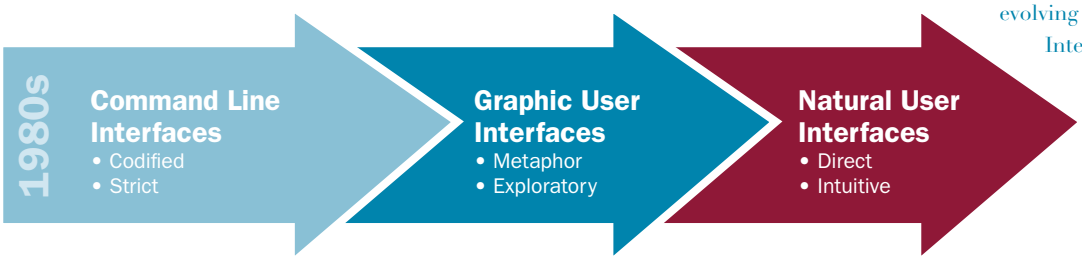
USB headphones are recommended, as they are typically plug-and-play devices. However, standard headphones connected via standard TRS (headphone jack) connections will suffice. Additionally, the computer-based read-aloud accommodation requires voice packs to be preinstalled on computers that will be used for testing. For Windows and Mac operating systems, default voice packs are typically preinstalled. For computers running Linux Fedora Core 6 (K12LTSP 4.2+) or Ubuntu 9–12, voice packs may need to be downloaded and installed. AIR tests a number of existing Windows and Mac internal voice packs as well as a number of fee-based external, third-party voice packs and releases a list of those best suited to the audio portions of their assessments.

It is assumed that most computers and similar devices come with requisite sound cards, but it is important to run the sample test, student tests, and diagnostic programs on all devices, particularly those that will be supporting audio in some form. At this time, neither microphones nor stylus devices have been identified as necessary input devices for the 2014–15 assessment implementation. However, Smarter Balanced anticipates integrating manipulative media and interactive data elements for students as a means to generate more authentic input capacities.

These advancements will ultimately help to capture predominant reasoning, drafting, revising, and general formative thinking processes taken by students when approaching solutions to various test items. Development in the arena of creating more Natural User Interfaces (NUI) that move away from the more codified and limited input facets of windows, icons, menus, and pointers and allow a student to create generative logic through writing, notation, computation, diagramming, and drawing, will assist in documenting student reasoning and overall performance. Multi-touch technologies like those present on most tablets will further enable these more natural input options; however, even stylus and pad devices made to operate on existing desktops and laptops can help expedite implementation of such features in the next three to five years on traditional form factors as well.

The Progression of Input Technologies

Input technologies transitioned from Command Line Interfaces (CLI) to Graphic User Interfaces (GUI) in the '80s and are now evolving into Natural User Interfaces (NUI).

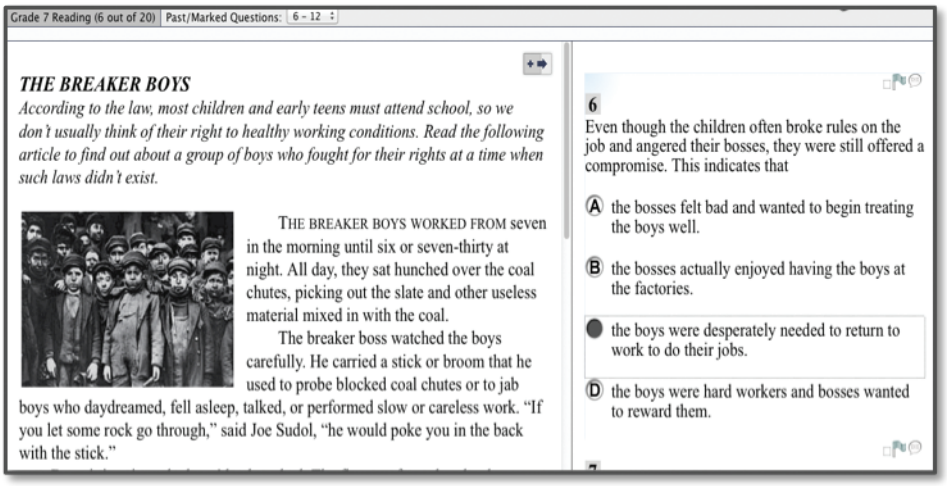


V. Planning for Future Technology Enhancement and Procurement

Smarter Balanced will review the minimum specifications annually and will target its end of support to align with the support timeline from the operating systems manufacturers. However, Smarter Balanced may determine based on input from its member states that Smarter Balanced's timeline needs to extend beyond the timeline from operating systems manufacturers.

A Reading Assessment Excerpt

The screenshot on the right shows a reading assessment excerpt from a recent AIR adaptive exam.



Based on the general research and data reviews conducted for the development of this guideline, most districts will find that much of their existing infrastructure and device inventory will serve to administer the online assessments. By all estimations at this time, the fear that states and districts will be forced to make large volumes of hardware and infrastructure purchases between now and the 2014–15 school year is not consistent with the implementation data available. However, some more specific areas will need a degree of review and consideration based on national trends at this time. While the Smarter Balanced assessment plans to support Windows XP configurations and will continue to include Windows XP in its specifications moving to 2015, it is recommended that districts consider migrating existing devices to Windows 7 where possible. This recommendation is due to the high number of Windows-based machines still using XP in the K-12 environment, and the fact that Microsoft will not provide security support to this OS beyond April of 2014. In general, Smarter Balanced will set a goal to support all prevalent operating systems at least two years beyond their own life cycle as indicated by the date in which they are removed from mainstream support by their authoring companies/agencies. The following is a table identifying the anticipated end-of-support dates for various operating systems in use today.

Operating System (OS)	OS Release Date	Anticipated Smarter Balanced End of Support Date
Mac 10.4.4	January 2006	Spring 2015[5]
Mac 10.5	October 2007	Spring 2017
Mac 10.6	August 2009	Spring 2019
Mac 10.7 Mac 10.8	July 2011 July 2012	Spring 2021 Spring 2022
Windows XP (SP 3)	October 2008	Spring 2015[5]
Windows Vista	January 2007	Spring 2017
Windows 7 Windows 8	October 2009 October 2012	Spring 2020 Spring 2022
Windows Server 2003	April 2003	Spring 2015
Windows Server 2008	October 2009	Spring 2019
Linux (Fedora Core 6 (K12LTSP 4.2+))	November 2007	Spring 2017[6]
Linux Ubuntu 9-12	October 2009	Spring 2019[6]
iOS 6	June 2012	TBD[6]
Android 4.x	October 2011	TBD[6]
Windows 8	October 2012	TBD
Chrome OS	Rolling Release	TBD[6]

[5] While the entire end of support plan will be reviewed annually with the Architecture Review Board, these particular OS versions will be emphasized and may require more detailed conversations.

[6] This operating system may have a lower cost to update than do traditional operating systems and will be placed on an expedited end of support cycle until the new operating system version becomes incompatible with legacy hardware that is otherwise considered eligible by Smarter Balanced.

"While the use of technology presents new and unique challenges, California looks forward to providing teachers and administrators immediate student performance data in relation to California's Common Core Standards as part of a growing need to move from paper and pencil assessment solutions to computer adaptive tests that can generate digitally-rich data for all stakeholders."

— José Ortega, Administrator California Department of Education & Smarter Balanced State Readiness

There will be instances in which districts might consider pooling more mobile units, like laptops or tablets within their district for transport from one school site to the next as testing windows are staggered across sites. In some instances, however, certain equipment was purchased and deployed to specific sites and to specific user populations with program funding that requires it be kept at a single site, or be appropriated for a single population as a condition of the corresponding funds. Districts will want to check out the use provisions for all assets in accordance with such documentation.

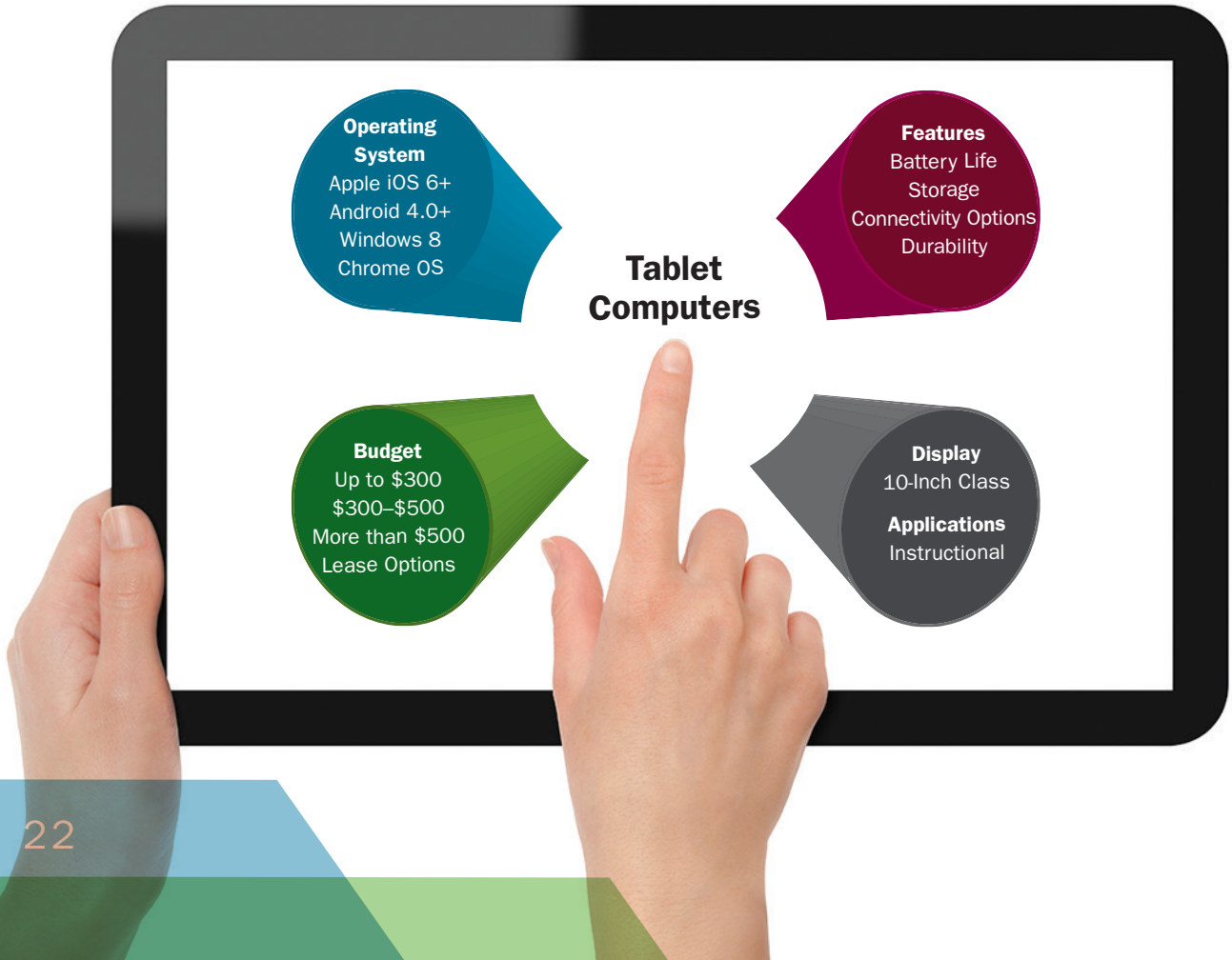
There will also be a need in certain scenarios for various districts to consider the purchase of additional computers or computational devices. As is standard for most districts, there will be purchasing guidelines and vendor relationships in place to dictate the types and specifications of units to be secured and integrated into existing site inventories. Most new hardware will naturally fall well into the specifications released so far by Smarter Balanced. District purchasing agents and technology officers should be diligent in working with their existing vendors to make them aware of the new hardware minimum recommendations to ensure that all new purchases meet or exceed those specifications.

Many districts have forayed into the mobile computing device market in the past few years. Whether deploying netbooks, tablets, or handheld devices, districts are opting to replenish some aging hardware with smaller, mobile units that are considerably different than their predecessors. One unique challenge this presents is when these new purchasing considerations fall outside of long-standing vendor arrangements that have historically obligated a district to use certain brands and models.

Like traditional computers, tablet-based computing devices run on a variety of operating systems (OS). The majority of tablets operate on one of the Android OS versions from Google since it can be operated across numerous vendor devices. Apple's popular tablet series (iPad, iPad2, the new iPad, and the iPad mini) operates exclusively on Apple's iOS. Microsoft has provided a tablet OS in the way of Windows 7 and recently released the Windows 8 version that is purported to be device agnostic. The Chromebook, also from Google, primarily operates as a cloud-computing device built around the Chrome browser with traditional features such as word processing handled via web-based applications as opposed to on-board software.

The tablet field will continue to grow. But like most logic models utilized by IT departments when considering any technologies, it is important to review a series of basic questions when analyzing available options on operating systems, such as display settings (specifically, on-screen keyboards that use some of the available interface), features, and price. Some considerations to keep in mind as part of an ongoing discussion among instructional specialists, district IT leads, and vendors should resonate around the various features desired in new mobile devices.

Districts should directly consult upcoming specification documents from Smarter Balanced and consider: storage space offered on the device, connectivity methods such as Wi-Fi and SIM-Based (cellular data provider plans), access to instructional applications and learning content providers, and durability for active transport and use by student population. While districts have a significant history with purchasing and support of more traditional form factors like laptops and desktops, the tablet and mobile computing device arena will pose a new consideration process for many.



VI. Matching Device and Content Needs with Assessment Capacity

A key strategy that unifies all states is ensuring that the devices used to execute upcoming assessments are also legitimate instructional support assets that serve the needs of teachers and students every day of the school year. As part of this effort, IT leaders will need to closely partner with instructional staff, administrators, library media specialists, and education technologists to chart a clear course toward enabling devices for both instruction and assessment.

> *"Districts and institutions of higher education need to understand that their information technology department is part of the effort to improve instruction but is not the only responsible department. Establishing a data-driven culture requires much more than simply buying a computer system. District staff from the information technology department need to join with assessment, curriculum, and instruction staff as well as top decision makers and work together to iteratively develop and improve data collection, processing, analysis, and dissemination."*
>
> — *Enhancing Teaching and Learning Through Educational Data Mining and Learning Analytics: An Issue Brief,* 2012; US Dept. of Education Technology

Historically, standardized assessments have not been synonymous with timely data tied intimately to instructional objectives and pacing from a given district, school, or teacher's perspective. Therefore, in many states, the major annual assessments have been seen as a limited method, at best, of assessing a school's efficacy. The assessment instruments and data-aggregation and delivery systems have been largely deemed inconsistent with the instructional planning and analyses process. The move to online, digitized assessments will help provide teachers and education leaders with a means to integrate strong summative pictures of student learning and accompanying interim performance data into yearlong planning and support.

Coordinating the most promising technical tools with growing amounts of quality, digitized content, rich, open data, and locally generated information on each student will help revise the image standardized assessments hold with educators. Considering the adaptive nature of

the Smarter Balanced Assessment Consortium model, the hope is to move teachers from the margins of the assessment dialogue to the center of the conversation. These assessments are not meant to be a means to an end, but a beginning to a better conversation about learning, instruction, and equity. With more quality data, we can ask questions like, "What are the critical skills students will require to not just live, but thrive in the 21st century?" And once we have identified those skills, how can we best measure them in a way that harmoniously underpins, not fractures, the creative, individualized, reflective environments teachers work to create in their own classrooms?

Students' performances are most significantly informed by the skills and expertise of the staff that teach them. Because of this, it is imperative that we work to give teachers the best information and tools possible as an instructionally valuable, internally threaded component to their practice. It is critical that teachers become stewards in assisting with the validity and consistency of these new tools and the data that is generated to help them better gauge practices that reinforce learning.

Each district will be joining thousands of other districts to respond to one of the largest and most critical directives given to education in the last 50 years: deploy a common set of standards and the means by which to assess them—in the next three years. This document and the research that supports it, as guided by partnering state input, district interviews, and principal agency and stakeholder review, is one of many points of information that will help public education respond to this historical imperative.

Delivering instructionally useful information to further enable the efficacy of teachers and provide all students individualized learning opportunities is a goal we must promise to keep.

Delivering programmatically useful data to aid in site-and district-level evaluation of support services is an overall objective we must work to embrace.

Delivering assessments online is the first step we must prepare to take.

For the most up-to-date information, please visit http://www.smarterbalanced.org.

"While my school-site lauds a battery of frequently administered homogeneous assessments as vital to quality education, I do not. On the contrary: My experience suggests that standardization of pedagogical practice and quality education are inversely related. Over the past thirteen years as a teacher, I've learned that the most meaningful, potentially life-changing classroom experiences are those least likely to leave a 'data trail.'"

— High School English Instructor

Testing and accountability should remain at the heart of national education policy. Equity and national prosperity depend on a system that will stretch educators, the education system, and communities to work toward high achievement and that will enable clear accountability when achievement goals are missed. But there should be new forms of assessment, functioning in new ways within the education system, to meet the needs.

— *An American Examination System,* Wireless Generation, Inc.; Resnick & Berger, et al. 2010